CSX Kanawha Trestle Inspection Report
Charleston, West Virginia

submitted to:

Chris Knox, City Engineer
City of Charleston
501 Virginia Street, East
Charleston, West Virginia 25301

submitted by:

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Charleston, West Virginia 25313

August, 2011

EXECUTIVE SUMMARY:

The CSX Kanawha Trestle is approximately 4,200 feet in length and is composed of short span Timber Trestles, medium span Steel Plate Girders and long span Steel Trusses. The Trestle was inspected by Michael Baker Jr., Inc in March and April, 2011. This report contains the overall summary of the inspection findings. Specifically, the sections of this report are as follows:

I. TRUSS SPAN SUMMARY
II. PLATE GIRDER SPAN SUMMARY
III. TIMBER TRESTLE SUMMARY
IV. DRAWING OF THE PROPOSED WALKWAY
V. CONSTRUCTION COST ESTIMATE FOR THE PROPOSED WALKWAY

APPENDIX A. UNDERWATER REPORT
APPENDIX B. CONCRETE COMPRESSION TESTS AND CHLORIDE TESTS

In general, the trestle is in fair condition however due to the size of the structure, small repairs over the entire length add up to significant construction costs. We estimated the cost of rehabilitating the trestle in order to provide a rails-to-trails walkway will be approximately $13 million. If the City wishes to paint the entire structure, it would add several million dollars to the project and bring the total cost up to approximately $17.5 million. Some of the biggest costs to the project involve: (1) Removing portions of the existing deck and providing a timber walkway on it, (2) Rehabilitating the concrete truss piers, (3) Providing handicap ramps, and (4) Repainting the structure. The construction cost does not include yearly maintenance and inspection costs that will be required and it does not include the eventual demolition cost.

I. Truss Spans

Figure 1 *Truss spans over the Kanawha River*

Figure 2 *Typical River Pier*

Figure 3 *Typical View of the Deck on the Truss Spans*

Figure 4 *Inspection of the River Piers*

Truss Spans Executive Summary

The 4 Truss Spans over the Kanawha River between River Piers 24 to 28 account for approximately 845 ft of the 4200 ft long trestle. The main truss that provides navigational clearance is approximately 415 ft long center to center of bearing and about 70 ft above the normal pool elevation of the river (See figure 1). The 2 flanking trusses on the South Charleston side are each approximately 150 ft long and the flanking truss on the Charleston side is approximately 130 ft in length. The truss spans were built in 1907 and rehabilitated in 1982. We were not able to determine the truss material used since the original plans were not provided by CSX. However, it is likely that the spans were designed for a Cooper E40 load which weighs 568,000 pounds over a length of 104 ft. The river piers are constructed of concrete and seem to have very little reinforcing steel in them. The trusses have been previously inspected in 2005 and Ultrasonic Testing was performed on 6 of the lower chord pins. Significant defects were not reported in the 2005 inspection. Since there was a substantial effort in evaluating the truss in 2005 and the truss is closed to traffic, our inspection of these spans was cursory and was carried out by climbing. The River Piers do not appear to have been inspected recently to any significant effort. As a result, we rappelled them on both faces (See figure 4) and through a subcontractor took core samples of the concrete for testing. In addition, an underwater report was performed by a sub-consultant. Both reports are provided as an appendix to this one and are summarized below.

The main issues that were noted in this inspection that require attention are:

1. The river piers are made of poor quality concrete by today's standards and are deteriorated significantly. The strength of the core samples revealed a concrete strength of approximately 1500 to 2500 psi in the upper portion of the pier shafts. Although chloride contamination does not seem to be a problem, the concrete strength and the condition of the piers in the upper 15 to 20 ft of the shaft beneath the truss bearings is in poor condition and exhibits concrete spalls up to 1 ft deep and extensive delamination, cracks and discoloration due to deteriorating concrete (See Photos 1-4 and Appendices). In addition to the deteriorated concrete, no reinforcing steel was found in the piers. Spalls and cores up to 12"deep at random locations did not encounter any rebar. As a result, significant strengthening will be required. Wrapping the piers with carbon fiber sheets is one possible method of strengthening the piers (Items 32 to 36 in the attached estimate).

2. The underwater report indicated that Pier 26 (the main river truss pier on the South Charleston side) has significant scour and the entire upstream nose of the footing is undermined approximately 5" vertically beneath the footing x 2'-6" horizontally in the direction of flow. In addition, several large spalls in the footing were found up to 36 inches deep. Spalls were also found in the footings of river piers 25 and 27. See the underwater report for more details. Concrete repairs

should be made to the footings to remove the undermining and repair the deteriorated concrete (Items 33 to 35 in the attached estimate).

3. Significant rust packing and corrosion at all top and bottom truss chord connections was found (See Photos 5 to 8). The rust packing and corrosion has led to additional stress on the pins and section loss to the ends of the eye-bars of the truss members. The tightness of the rust packing and extent of the corrosion made it impossible to determine the remaining section. As part of the rehabilitation, we recommend blast cleaning the pin areas, re-inspecting the eyebars and ultrasonically test the pins. These areas also need to be repainted to prevent further deterioration. If the UT testing or the re-inspection reveals defects during construction, additional repairs may be required (Items 23 and 24 in the estimate).

4. The top lateral bracing for the main river truss and the flanking trusses have up to 50% section loss with small through holes at the connection to the top chord. It is estimated
that several of these deteriorated areas will have to be reinforced as part of the rehabilitation of the bridge (See Photo 9 and repair item 25 in the attached estimate).

5. The bottom chord and diagonal at L0, Pier 24 for the flanking truss have significant section loss and should be strengthened (See Photo 10 and Item 26 in the estimate).

6. The navigational lights do not appear to be functional. The Coast Guard requires navigation lights over navigable rivers and clearance gauges on the main river piers (See Photos 11, 12 and Items 27 & 28 in the estimate).

The estimate with repair items following this document give several other areas that require attention but may not be quite as serious as those mentioned above.

Photos

Photo No. 1 Pier 25, north face, downstream
Condition: Extensive deterioration with spalls up to 1 ft deep

Photo No. 2 Pier 24, top of cap, downstream truss bearing
Condition: Severe map cracking adjacent to the truss bearing

Photo No. 3 Pier 25, south face, downstream

Condition: Cracking, delamination. and spalling in the upper pier shaft

Photo No. 4 Pier 26, downstream, south face

Condition: Severe scaling and open construction joint with spalling at the waterline

Photo No. 5 Bottom chord, truss span, Pier 27 to Pier 28

Condition: Typical view of the truss span

Photo No. 6 L2, DS Truss Between P24 and P25

Condition: 1" Rust pack with significant section loss to truss members

Photo No. 7 Main River Truss, L4', Downstream Truss

Condition: ¼" section loss to the eyebars with ½" rust pack

Photo No. 8 Main River Truss, Top Chord at U4, DS Truss

Condition: Up to 1" rust pack with ¼" section loss to chord plate around the pin plate

Photo No. 9 Main River Truss, Top Chord at U2', DS Truss

Condition: Up to 50% Section Loss to the end of the top lateral and the gusset plate

Photo No. 10 Pier 24, US Truss at L0

Condition: Web of diagonal is 50% gone around pin and bottom eyebars have 1" of 1-3/8" remaining

Photo No. 11 Main River truss at mid-span, US truss

Condition: Missing navigation light

Photo No. 12 Main River truss, DS truss

Condition: Navigation Lights not working and no clearance gauges on piers

Photo No. 13 Top Chord, upstream truss between P 27 and P 28

Condition: Typical condition of the paint with possible red lead primer beneath

II. Steel Plate Girder Spans

Figure 1 *General Underside View of Typical Steel Spans*

Figure 2 *General Elevation View of Typical Steel Spans*

Steel Plate Girder Spans Executive Summary

There are 13 steel plate girder spans, measuring approximately 580 ft in length on the South Charleston side, leading up to the Kanawha River crossing. These spans cross McCorkle Avenue and a local street. Overall, these spans are in fair condition. There are 22 steel plate girder spans, measuring approximately 860 ft. in length on the Charleston side after the Kanawha River crossing. These spans cross Kanawha Blvd. and 2nd Ave., paralleling the new West Side Elementary. Overall, these spans are in poor condition. Additionally, there are Steel spans crossing Grant St., Main St., Central Ave., and 6th St. The steel spans are typically supported by steel tower bents. An 80 ft. man-lift and ladders were used to inspect the spans and bents.

The main issues that were noted in this inspection that require attention are:

1. The bottom flange at several bents has 50% to 100% section loss at the girder bearing area. This condition is fairly typical to both girders in the steel spans on the Charleston side to various degrees. (See Photos 1 to 3)

2. There is a 10 ft. span between bent A5 and A6 over the sidewalk adjacent to 2nd Ave. This span has numerous defects and could potentially be replaced. The bottom flange is deteriorated to the point that the girder is bearing on its web. The top flange has an area that exhibits 100% section loss to the interior angle leg. The cross frame angles have up to 50% section loss. (See Photos 4 to 6)

3. Several of the concrete pedestals that support the steel tower bents are in need of repairs. They typically exhibit map cracking with up to 1/8" wide open cracks as well as spalls and crumbling concrete. (See Photos 7 to 8)

4. During the inspection there were several bent column base connections and anchor bolts that were in poor condition. Anchor bolts were found to be missing, broken and loose. The bent column base connection was typically found to be full of debris and exhibits heavy surface rust and section loss. (See Photos 9 to 10)

5. The bottom 5 ft. of all the steel bent towers should be blast cleaned and painted. These areas typically exhibit accelerated deterioration due to moisture. Paint peeling, advanced surface rust and section loss were observed in these locations.

The estimate with repair items following this document give several other areas that require attention but may not be quite as serious as those mentioned above.

Photos

Photo No. 1 Girder 2 at Bent B45
Condition: 100% section loss to the bottom flange angles

Photo No. 2 Girder 2 at Bent A1
Condition: 90% section loss to bottom flange (See Arrow)

Photo No. 3 Girder 2 at Bent A2
Condition: 100% section loss to the inside bottom flange angle

Photo No. 4 Span A5 – A6, Sway Bracing Angles
Condition: Sway Bracing has up to 50% section loss

Photo No. 5 Girder 1 Bearing area at Bent A5
Condition: Girder bearing on its web due to flange deterioration

Photo No. 6 Girder 1 at Bent A6
Condition: Bottom flange deteriorated at X-bracing support

Photo No. 7 Bent B15 (other locations similar)

Condition: Map cracking with 1/8" wide open cracks

Photo No. 8 Bent B30 (Median of Kanawha Blvd.)

Condition: Up to 3" deep spall to pedestal

Photo No. 9 Bent B8 (South Charleston Side)

Condition: Broken anchor bolt

Photo No. 10 Temporary bent support at Bent B33

Condition: Repair bent column base connection, pedestal and anchor bolts

III. Timber Spans

Figure 1 *General View of Timber Spans*

Figure 2 *Typical View of Timber Bent*

Timber Spans Executive Summary

There are 84 timber stringer spans on the South Charleston side of the river and 75 total timber stringer spans on the Charleston side of the river making up approximately 1915 ft of the 4200 ft long trestle. The overall condition of the timber section is fair. The timber bent sill caps that are exposed to the ground generally have a significant degree of rot. There are various timber posts and diagonals that have splits and checks, and most of all bearing shims are decayed or crushed. The stringers show various degrees of rot with most of the defects occurring on the top face and at the caps where trapped moisture is more likely. The concrete pedestals under most of the bents are in good condition. From prior experience and design standards of the period when this bridge was built it is likely that the spans were designed for a Cooper E40 load which weighs 568,000 pounds over a length of 104 ft

The main issues that were noted in this inspection that require attention are:

1. Timber bent caps at several locations show different degrees of decay. This condition is evident on both sides of the river (See Photo 5). This repair is quantified in item #15 and item #49 on the cost estimate.

2. Several of the longitudinal and transverse bracings have fallen or are split and unable to transfer load (See Photo 13). These braces need to be replaced and is quantified in items #11, #13, #46, and #48 on the cost estimate.

3. The timber bent sills in select locations show large amounts of rot (See Photos 10 and 12). These sills need to be replaced and they are quantified in item #12 and item # 47 on the cost estimate.

4. The bearing shims on top of the bent caps are crushed or rotten in multiple locations (See Photos 2,3, & 6). These shims should be replaced and they are quantified in item #16 and item #50 on the cost estimate.

5. Several timber posts are excessively split and their load carrying capacity is reduced (See Photo 11). These posts should be replaced and are quantified in item #51 on the cost estimate.

6. On the Charleston side of the river, several timber bents and stringers were damaged due to fire (See Photo 8). This area should be coated with the possibility of some members that are excessively damaged to be replaced. This cost is included in item #45 on the cost estimate.

The estimate with repair items following this document give several other areas that require attention but may not be quite as serious as those mentioned above.

Photos

Photo No. 1 Timber Bent T73
Condition: Vertical Split in Post affecting 15% of pile area.

Photo No. 2 Timber Bent T72
Condition: Shim block is 50% rotted, replace

Photo No. 3 Timber Bent T72
Condition: Timber Shim is split and brooming.

Photo No. 4 Deck ties along stringer 1.
Condition: Deck ties split at end, typical 50% of ties

Photo No. 5 Timber Bent T80
Condition: 35% of cap is decayed

Photo No. 6 Timber Bent T81
Condition: Bearing shims are crushed

Photo No. 7 Timber Bent T84

Condition: Bent Cap is tilting, needs reset

Photo No. 8 General View T112 – T121

Condition: Fire Damage

Photo No. 9 Timber Bent T120

Condition: 4" dia. Hole and full height split in post

Photo No. 10 Timber Bent T114

Condition: Sill completely rotted, replace

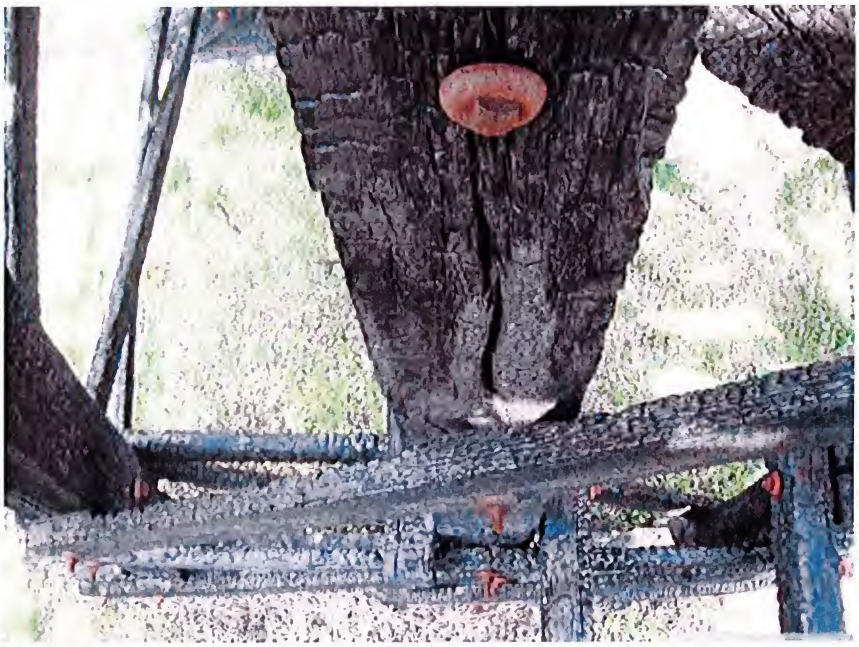


Photo No. 11 Timber Bent T116

Condition: Post Split, full height

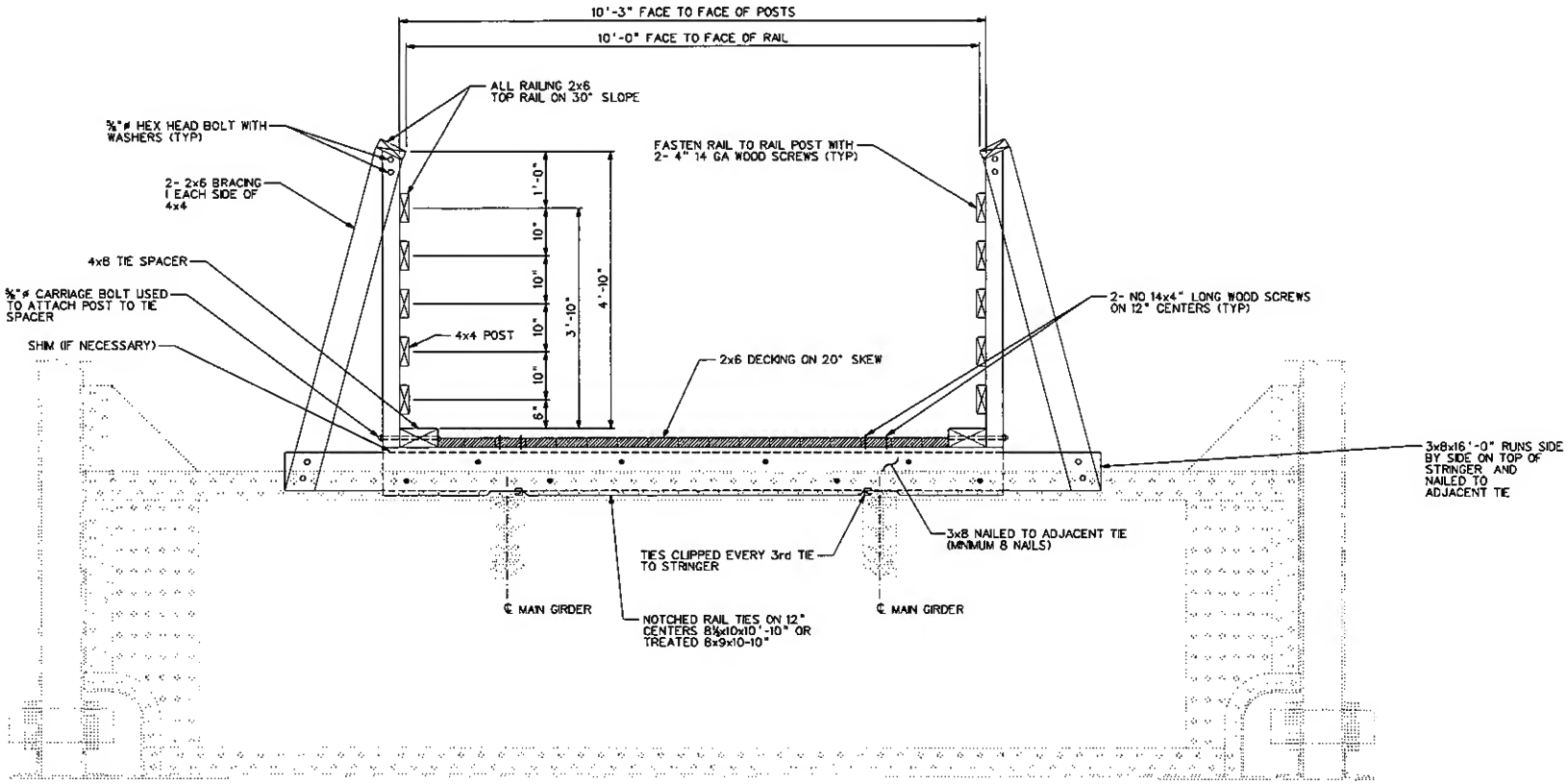
Photo No. 12 Timber Bent T35

Condition: End of Sill rotting, undermining support post

Photo No. 13 Timber Tend T43
Condition: Typical Split in Diagonal Bracing

IV. Drawing of the Proposed Cross Walkway

State Project No.	Federal Project No.	State Dist. No.	Year	County	Sheet No.	Total Sheets
			2011	KANAWHA		



NOTE:
DECKING, RAILING, CURB PLATES SHOULD BE FASTENED USING GALVANIZED DECKING SCREWS

TYPICAL SECTION

FLOORBEAMS ON TRUSS SPANS
TIMBER OR STEEL GIRDERS ON TRESTLES

NO.	REVISION	DATE:	BY:

CITY OF CHARLESTON
BRIDGE REHABILITATION

CSX KANAWHA TRESTLE TYPICAL SECTION FOR PROPOSED 10'-0" TIMBER WALKWAY

DESIGNED		DATE 0809
DRAWN		0809
CHECKED		0809
CHECKED		0809

Baker
Michael Baker Jr., Inc. Charleston, W.Va.

SHEET OF
BRIDGE NO.

V. Construction Cost Estimate For The Proposed Walkway

KANAWHA TRESTLE COST ESTAIMATE FOR 10 FOOT TIMBER WALKWAY					
ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
	GENERAL				
1	REMOVE RAILROAD RAILS	LS	1	$735,000.00	$735,000.00
2	REMOVE WALKWAY, RAILING, AND CANTILEVER SUPPORTS	LS	1	$425,000.00	$425,000.00
3	REMOVE INACTIVE UTILITY LINES	LS	1	$75,000.00	$75,000.00
4	REMOVE OVERGROWN VEGETATION	LS	1	$50,000.00	$50,000.00
5	REMOVE AND REPLACE DETERIORATED TIES	LS	1	$319,000.00	$319,000.00
6	TIMBER WALKWAY	SF	42,000	$11.00	$462,000.00
7	RAIL SYSTEM FOR WALKWAY	LF	8,400	$70.00	$588,000.00
8	WALKWAY LIGHTING	LS	1	$600,000.00	$600,000.00
	TIMBER TRESTLE				
	(SOUTH CHARLESTON SIDE T1-T83)				
9	FIX DRAINGAGE/PONDING ISSUE NEAR T19	LS	1	$5,000.00	$5,000.00
10	REGRADE AREA SO CONCRETE FOUNDATIONS ARE EXPOSED	LS	1	$5,000.00	$5,000.00
11	REPLACE BROKEN/FALLEN BRACES	EA	11	$3,000.00	$33,000.00
12	REPAIR ROTTED SILL ENDS	EA	8	$6,000.00	$48,000.00
13	REPAIR APPROX. 50% OF SPLIT BRACES	EA	17	$3,000.00	$51,000.00
14	REPLACE DETERIORATED SHIMS BELOW SILLS	EA	2	$5,000.00	$10,000.00
15	REPAIR BENT CAPS	EA	20	$7,500.00	$150,000.00
16	REPLACE SUPERELEVATED SHIM BLOCKS ON BENT CAPS	EA	20	$2,000.00	$40,000.00
	STEEL TRESTLE				
	(SOUTH CHARLESTON SIDE B6-PIER 24)				
17	REPAIR GIRDER BOTTOM FLANGE TO TOP BENT PLATE (B19-B24)	EA	3	$4,000.00	$12,000.00
18	BLAST/CLEAN AND PAINT BOTTOM 5 LF. OF STEEL BENTS	LF	432	$125.00	$54,000.00
19	REPAIR BOTTOM OF BENT COLUMN AT BASE CONN. PLATE AND ANCHOR BOLTS	EA	4	$8,000.00	$32,000.00
20	REPAIR CONCRETE PEDESTAL	EA	3	$6,000.00	$18,000.00
21	CURVE ACCESS RAMP TO WALKWAY (SOUTH CHARLESTON)	LS	1	$1,400,000.00	$1,400,000.00
22					
	TRUSS REPAIRS-SUPERSTRCTURE				
	(ALL TRUSSES')				
23	CLEAN RUST PACK FROM ALL TRUSS PIN CONNECTIONS AND PAINT THOSE AREAS	LS	1	$186,000.00	$186,000.00
24	ULTRASONIC TESTING OF ALL PINS	EA	124	$300.00	$37,200.00
25	REINFORCE APPROXIMATELY 6 TOP LATERAL GUSSETS (3 US AND 3 DS) AND THE END OF THE LATERALS EACH TRUSS	EA	6	$5,000.00	$30,000.00
	TRUSS BETWEEN PIERS 24 AND 25				
26	REINFORCE DIAGONAL, BOTTOM CHORD AND PIN PLATE AT BEARING AREA, PIER 24 BOTH UPSTREAM AND DOWN STREAM TRUSS. THERE IS UP TO 50% LOSS.	EA	2	$10,000.00	$20,000.00
	MAIN RIVER TRUSS				
27	REPLACE NAVIGATION LIGHTS	LS	1	$50,000.00	$50,000.00
28	PAINT COAST GUARD CLEARANCE GAUGES	LS	1	$40,000.00	$40,000.00
	TRUSS BETWEEN PIERS 27 AND 28				
29	REPLACE STRINGER SUPPORT FOR WALKWAY BEAM AT PIER 27	EA	1	$4,000.00	$4,000.00
30	REPLACE 4 ANCHOR BOLTS US AND DS AT PIER 27	EA	8	$1,000.00	$8,000.00
31	REMOVE THE COLLAR SPACERS AT THE PINS	EA	124	$400.00	$49,600.00
32	REPAIR PIER 24	LS	1	$388,000.00	$388,000.00
33	REPAIR PIER 25	LS	1	$687,000.00	$687,000.00
34	REPAIR PIER 26	LS	1	$850,000.00	$850,000.00
35	REPAIR PIER 27	LS	1	$687,000.00	$687,000.00
36	REPAIR PIER 28	LS	1	$388,000.00	$388,000.00
	STEEL TRESTLE				
	(CHARLESTON SIDE PIER 28-A6 & OVER STREETS)				
37	CURVE ACCESS RAMP TO WALKWAY (KANAWHA BOULEVARD)	LS	1	$1,400,000.00	$1,400,000.00
38	BLAST/CLEAN AND PAINT BOTTOM 5 LF. OF STEEL BENTS	LS	1	$176,000.00	$176,000.00
39	REPLACE 10 LF. DECK PLATE GIRDER SPAN BETWEEN A5-A6	LS	1	$125,000.00	$125,000.00
40	REPAIR BOTTOM OF BENT COLUMN AT BASE CONN. PLATE AND ANCHOR BOLTS	EA	15	$6,000.00	$90,000.00
41	REPAIR CONCRETE PEDESTALS	EA	6	$2,000.00	$12,000.00
42	REPAIR LOWER LATERAL BRACE CONN. AT BOTTOM OF BENT	EA	16	$3,000.00	$48,000.00
43	REPLACE/REAPAIR CROSS FRAMES	EA	3	$5,000.00	$15,000.00
44	REPAIR GIRDER BOTTOM FLANGE CONN. TO TOP OF BENT PLATE	EA	22	$4,000.00	$88,000.00
	TIMBER TRESTLE				
	(CHARLESTON SIDE T84-T158)				
45	COAT OVER FIRE DAMAGED TIMBERS T130 TO T121	LS	1	$50,000.00	$50,000.00
46	REPLACE BROKEN/FALLEN BRACES	EA	8	$3,000.00	$24,000.00
47	REPAIR DETERIORATED SILL ENDS	EA	2	$4,000.00	$8,000.00
48	REPAIR SPLIT BRACES	EA	11	$2,000.00	$22,000.00
49	REPAIR DETERIORATED BENT CAPS	EA	9	$5,000.00	$45,000.00
50	REPLACE DETERIORATED/DAMAGED SHIMS ON BENT CAPS	EA	4	$1,500.00	$6,000.00
51	REPAIR EXCESSIVELY SPLIT/DAMAGED BENT POSTS	EA	3	$5,000.00	$15,000.00

SUB TOTAL	**$10,660,800.00**
CONTINGENCY 20%	**$2,132,160.00**
TOTAL	**$12,792,960.00**

	ADDITIONAL COST	
52	CONSIDER REPAINTING THE ENTIRE SURFACE OF ALL TRUSSES DO TO MINOR SURFACE CORROSION AND CHALKY PAINT APPEARANCE	$2,712,250.00
53	WASH CLEAN AND PAINT STEEL TRESTLE FROM SOUTH OF KANAWHA BOULEVARD TO 6TH STREET	$995,880.00
54	WASH CLEAN AND PAINT STEEL TRESTLE FROM SOUTH CHARLESTON END TO SOUTH END OF TRUSSES	$931,500.00

TOTAL INCLUDING ALL ADDITIONAL COST $17,433,590.00

APPENDIX A

UNDERWATER INSPECTION
OF
KANAWHA TRESTLE
KANAWHA RIVER PIERS
IN
CHARLESTON, WEST VIRGINIA

JULY 2011

PREPARED FOR
MICHAEL BAKER, JR., INC.
CHARLESTON, WEST VIRGINIA

PREPARED BY
GAF UNDERWATER INSPECTIONS
CHARLESTON, WEST VIRGINIA

UNDERWATER INSPECTION
OF
KANAWHA TRESTLE
KANAWHA RIVER PIERS
IN
CHARLESTON, WEST VIRGINIA

INSPECTION DATE: JUNE 6, 2011

REPORT DATE JULY 13, 2011

Robert N. Amos, Jr., P.E. - Inspection Team Leader

Date

Prepared By:
GAF Underwater Inspections
2834 Putnam Avenue
Hurricane, WV 25526

UNDERWATER INSPECTION
OF
RAILROAD TRUSS BRIDGE
OVER
KANAWHA RIVER
IN
CHARLESTON, WEST VIRGINIA

1. INTRODUCTION

1.1 This structure, a multiple-span combination of steel and timber truss and girder spans carried rail traffic for the CSX Corporation across the Kanawha River in Charleston, WV. This facility is known locally as the Kanawha Trestle. This structure has been abandoned and is under consideration by the City of Charleston for inclusion in a pedestrian and bicycle trail. The subject of this Report is the Underwater Inspection of the three piers which support the through trusses within the limits of the Kanawha River.

1.2 The engineering firm Michael Baker Jr., Inc. (Baker), has been retained to assess the feasibility and cost of repairing the structure to convert this bridge to a pedestrian and bicycle trail. It is necessary to perform structural inspections of the bridge as part of this assessment. Baker retained GAF Underwater Inspections (GAF) to perform an inspections of the submerged portions of its foundation.

1.3 GAF performed the underwater inspection on June 6, 2011. This report documents the findings of that inspection.

1.4 The inspection was performed by a three-person team consisting of a professional engineer-diver and team leader (Robert N. Amos, Jr., P.E.), and two technician divers (Stewart G. Groves and James C. Fisher). The inspection was conducted using self-containing underwater breathing (Scuba) equipment. The team operating from a pontoon boat launched from Pier 54, located in Charleston, about a mile downstream from the bridge.

1.5 This is considered the initial inspection of this bridge, for no record of any previous inspection has been discovered.

2. OBSERVATIONS

2.1 The subject bridge contains three piers within the normal channel flow of the Kanawha River. The piers were numbered with Pier 1 (not a "wetted" pier) being the most southern and Pier 5 (also not "wetted") being the most northern. The piers with submerged portions were Piers 2, 3, and 4.

2.2 These piers are constructed of Portland cement concrete. Each pier is five sided: generally a rectangular shape aligned with the flow lines of the river, but with a sharp, two-sided nose pointing upstream. The proportion of the footer exposed varied from pier to pier. This is shown in Figure 1 and Figure 2. A picture of this bridge was taken from the eastern side facing west and is included on the coversheet of this report.

2.3 A feature peculiar to all the inspected piers, was an odd periodic appearance of large timbers that seemed to penetrate completely through the footings. Perhaps the penetrating timbers functioned as braces for the cofferdams. If so, they present a discontinuity in the concrete members.

2.4 At some places there were large timbers that appeared to be formwork that was left in place.

2.5 Dimensions, soundings, and other pertinent information are shown in Figure 1 and Figure 2. Soundings were taken immediately adjacent to each pier and approximately six feet out into the river channel from each pier or, if it is exposed, from the edge of the pier footing.

2.6 As a point for future reference, the water line at the time of this inspection was 5'-8" feet below the top end of an H-beam that stood vertical and was attached to the downstream end of Pier 3 at the location shown in Figures 1 and 3.

2.7 Pier 2

2.7.1 The concrete comprising this pier exhibited a 6- to 9-inch deep band of scaling from 6 inches above the water line to 6 inches below the water line. Below this it transitions to medium scaling at the channel bottom.

2.7.2 A rectangular concrete footer was observed beneath this pier. The footer comprised two steps. The first step below the water surface extended 9 inches from the stem, the second extended about 1 foot beyond the first. The first shelf was positioned 12"-6" below the water line. The second was 15'-6" below the water line.

2.7.3 Both steps of the footing were exposed completely around the pier, including both noses, except the deeper layer was covered for the downstream half of the shore side. The exposure at the upstream nose was mostly covered by large logs.

2.7.4 The concrete footing was heavily eroded.

2.7.5 No fractures were noted on this pier, although a large void was noted about one-third of its length downstream, shore side corner. See Figure 2. The void in the concrete appeared about 6 inches from the channel bottom. It was 12 inches high, 4 feet long, and 2 feet deep.

2.7.6 No undercutting was found beneath this pier.

2.7.7 The river bottom surrounding this pier consisted of silt and cobbles.

2.7.8 Large tree debris was present on the upstream nose of this pier. One piece was a 12-inch log near the upstream, shore (southern) corner.

2.8 Pier 3

2.8.1 The concrete comprising this pier exhibited a 6- to 9-inch deep band of scaling from 12 inches above the water line to 6 inches below the water line. Below this band, the scaling transitions to medium to the channel bottom.

2.8.2 A rectangular concrete footer was observed beneath this pier. It appeared to comprise multiple steps or shelves. The deepest shelf was 12 inches in width and the topmost was 9 inches wide. On the channel side only, there appeared a 5-inch wide shelf situated 12 inches above the bottom shelf. The depth to the topmost shelf was 12'-6". The concrete was heavily eroded, so these measurements are approximate.

2.8.3 The lowest shelf was exposed around the pier, except the downstream, channel corner, which was covered.

2.8.4 Although no fractures were noted on this pier, there was considerable distress in the form of significant erosion of the concrete.

2.8.5 At the downstream, shore-side corner, the lowest ledge had completely eroded away. This erosion continued for 3'-7" along the shore side of the pier and for 3 feet along the downstream nose. At these points, the shelf was 5'-4" high above the river bed. (See Figure 5)

2.8.6 Also in the vicinity of the downstream, shore-side corner, at 2'-10" above the river bed, a significant groove had eroded into the concrete. This groove was about 6 inches wide. It ran about 5'-0" along the nose; its depth at the nose was 10 inches. Along the shore side it carried 5 feet from the corner; it varied from 1'-0" to 1'-6" deep. At the corner, it measured 1'-10" deep diagonally into the groove.

2.8.7 Another similar groove appeared situated around this same downstream, shore-side corner. This groove was about 6 inches wide. It appeared at 5'-6" above the bottom shelf of the footing. It carried 4'-0" along the shore side and for 5'-0" along the nose. Throughout this length, the depth varied from 6 inches to 10 inches.

2.8.8 Similar to the shore side, at the downstream channel side corner, the topmost ledge at the channel side corner had completely eroded away. This erosion continued for 2 feet along the channel side of the pier and for 3 feet along the downstream nose.

2.8.9 The footer was missing from the downstream channel corner, extending about 3 feet upstream. It could not be determined whether this section was missing owing to being either eroded, broken, or from original construction. The footer was also this corner, extending about 2 feet across the downstream nose.

2.8.10 An associated significant defect was found situated at the stream bed at this same downstream nose at the corner on the channel side. The concrete at this corner had eroded so that a large void was situated 3 feet above the bed level. It was 2 feet high and 3 feet deep. It extended about 3 feet into the downstream nose.

2.8.11 On the channel side at the downstream corner, a significant erosion defect was also noted. This defect appeared as a 12-inch deep groove that appeared 3 feet above the channel bed and extended for 2 feet above that. It ran from the corner for 2 feet upstream.

2.8.12 The river bed beneath the upstream nose of the pier was undercut for its entire width. The dimensions of the undercut varied, but averaged 2'-6" deep and 4 inches to 6 inches in height.

2.8.13 A 9-inch x 9-inch timber, apparently from the original construction, rested atop the lowest bench of the footer. It lay all along the channel side from about the point of the break for the point of the pier's to the point of the above-mentioned missing corner.

2.8.14 Figure 7 depicts a large timber that projects about 6 inches normal to the pier face toward the shore side. This timber appears to be bracing for the formwork or a cofferdam and is similar to those mentioned in paragraph 2.3.

2.8.15 A 1.5-inch wide vertical gap at the midpoint shore side of the pier. It was very regular and seemed formed, that is it did not seem to have been the result of concrete deterioration. (See Figure 6)

2.8.16 The river bottom surrounding this pier consisted of sand and cobbles.

2.8.17 No debris was noted in the vicinity of the pier.

2.9 Pier 4

2.9.1 The concrete comprising this pier exhibited a 6- to 9-inch deep band of scaling from 6 inches above the water line to 6 inches below the water line. From there, medium scaling was observed for about 3 feet, then another 2 feet of severe scaling. Below this, the scaling transitioned from medium to fine at the channel bottom.

2.9.2 A rectangular concrete footer was observed beneath this pier. This footer was completely exposed on the channel (southern) side, but covered on the shore (northern) side. As shown in Figure 1, each nose was exposed only on its channel half. This footer extended 9 inches from the stem and was located 11'-5" below the waterline.

2.9.3 The downstream, channel corner of the footer was heavily eroded. The erosion of the concrete was 6- to 8-inches deep.

2.9.4 No fractures were noted on this pier.

2.9.5 There was no undercutting found beneath this pier.

2.9.6 The river bottom surrounding this pier consisted of sand.

2.9.7 Tree debris was present on both sides of this pier. Large pieces consisting of 4- to 6-inch logs were present on the upstream nose.

3. DIVER'S LOG ENTRIES

Divers in attendance:	Robert Amos (Designated Person in Charge per OSHA Standard 1910.423(d)) James Fisher Stewart Groves
Maximum measured depth:	21'-6"
Beginning inspection time:	11:10 am
Beginning Bottom Time:	11:30 am
Total inspection time:	4 hour, 00 minutes
Bottom time for each diver:	3 hour, 30 minutes
Visibility:	3 to 5 feet
Current:	Negligible to Mild (varied during inspection)
Water temperature:	76°F
Air Temperature:	80°F

4. SUMMARY

4.1 In the opinion of the inspecting divers, the condition of Piers 2 and 4 should be rated as good. The undercutting into the river bed beneath Pier 3 and the extent of concrete erosion dictate its condition be classified as fair.

4.2 Figures 3 through 7 are photographs that depict the situation and some of the deficiencies of this bridge

4.3 A location map is included as Figure 8.

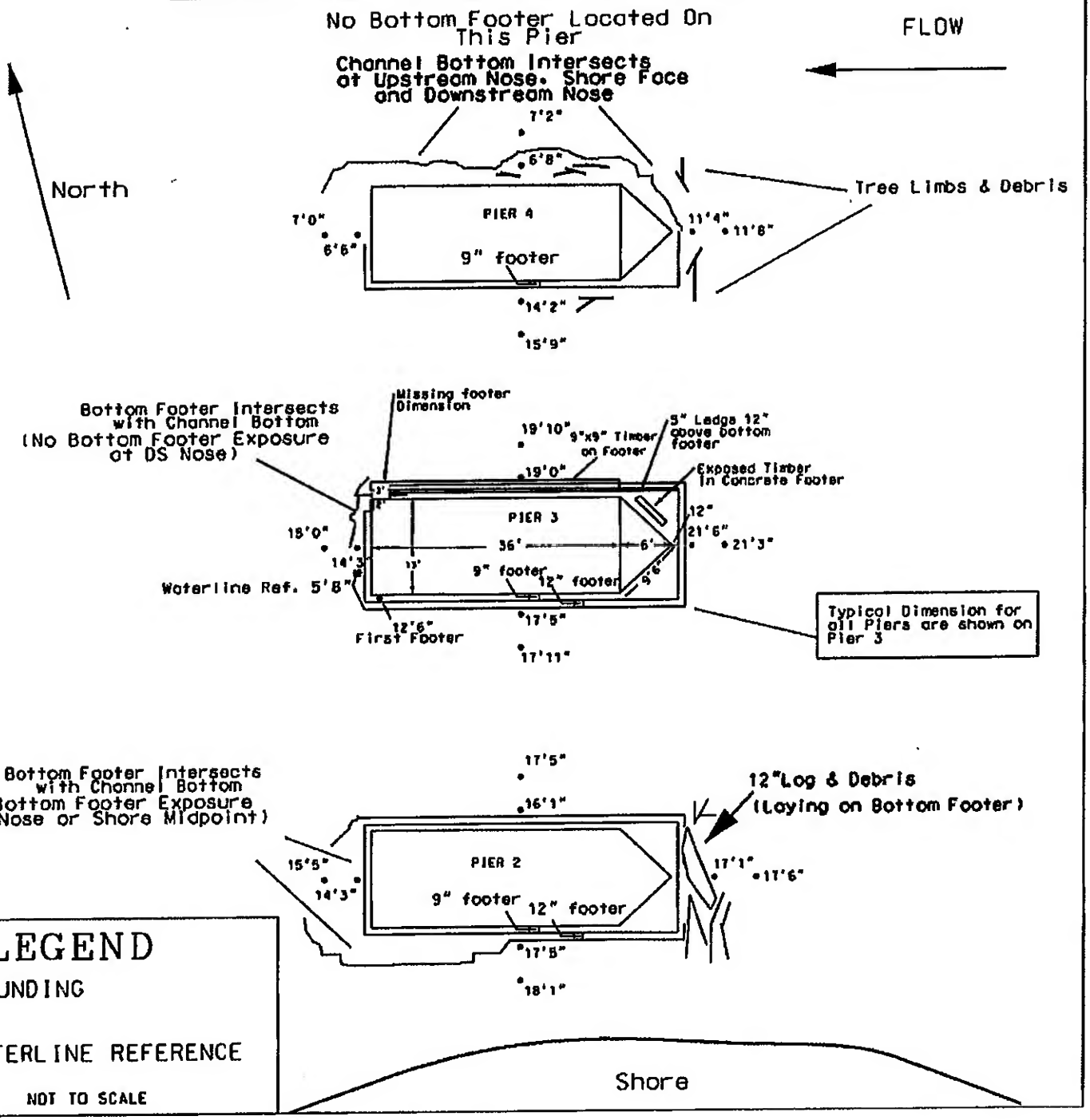
APPENDIX:

FIGURES

GAF UNDERWATER INSPECTIONS

UNDERWATER BRIDGE INSPECTION	BRIDGE NO. RAILROAD TRUSS BRIDGE OVER KANAWHA RIVER	1 OF 2
PREPARED BY: J.FISHER DATE: 6-9-11	COUNTY: KANAWHA	

FIGURE 1. PLAN VIEW OF PIERS



LEGEND

- SOUNDING
- * WATERLINE REFERENCE

NOT TO SCALE

GAF UNDERWATER INSPECTIONS

UNDERWATER BRIDGE INSPECTION	BRIDGE NO. RAILROAD TRUSS BRIDGE OVER KANAWHA RIVER	2 OF 2
PREPARED BY: J.FISHER DATE: 6-9-11	COUNTY: KANANWHA	

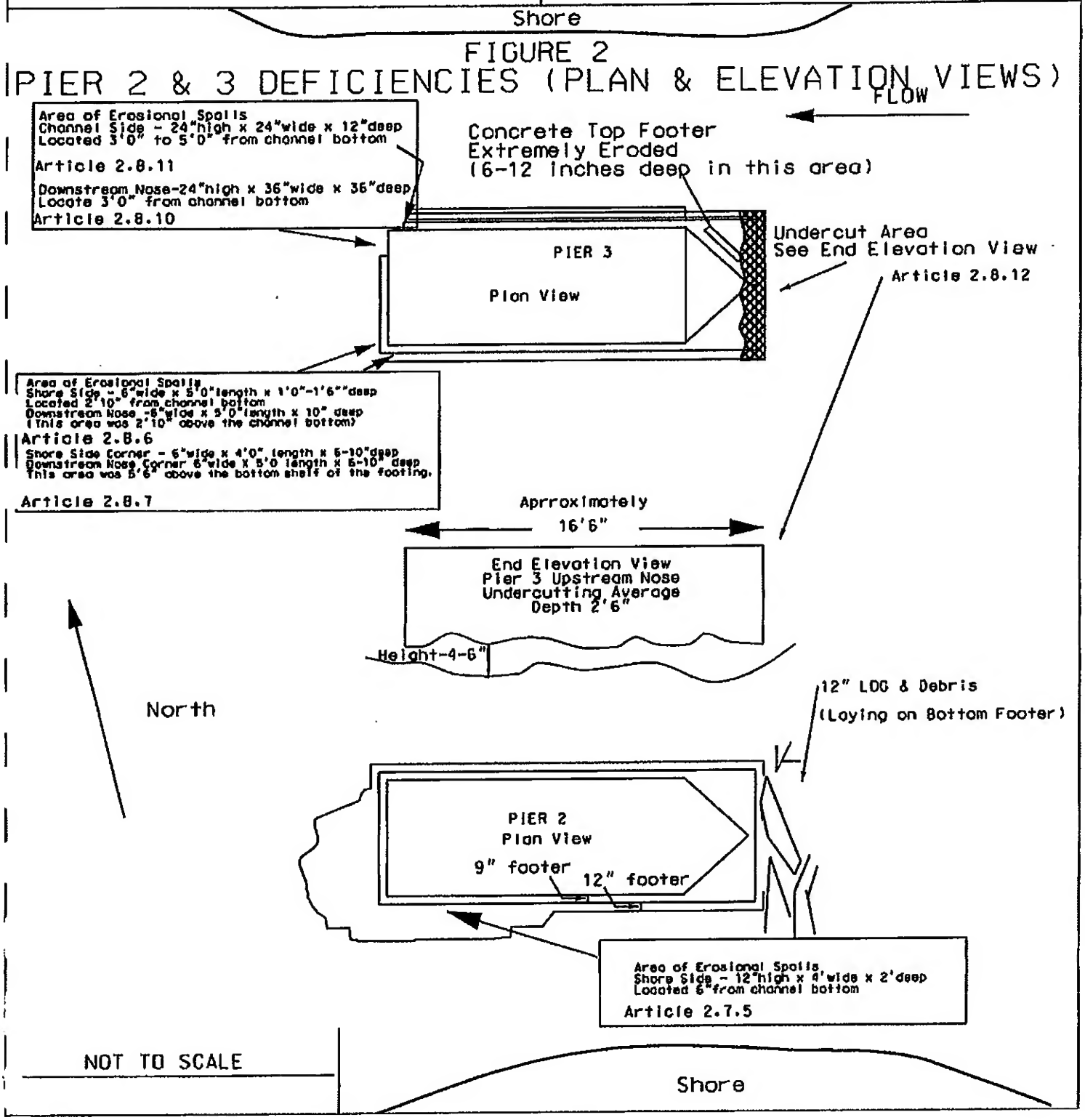


Figure 3. Waterline reference located on the downstream nose of Pier 3

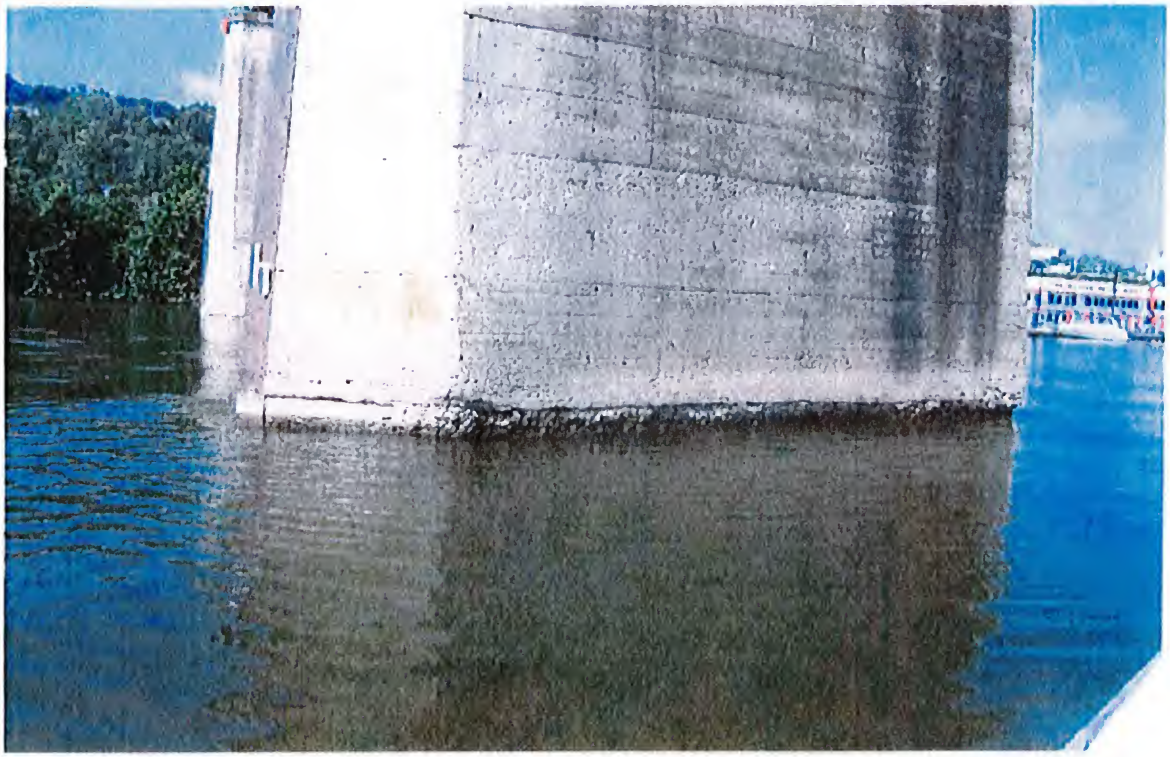


Figure 4. Severe concrete scaling at the waterline of Pier 3 (looking downstream)

Figure 5. An area of eroded concrete on the corner of the downstream nose shore side of Pier 3

Figure 6. A 1.5 inch vertical gap located underwater approximately at the midpoint on the shore side of Pier 3

Figure 7. A wooden timber found underwater extruding out approximately 6" from the shore side of Pier 3.

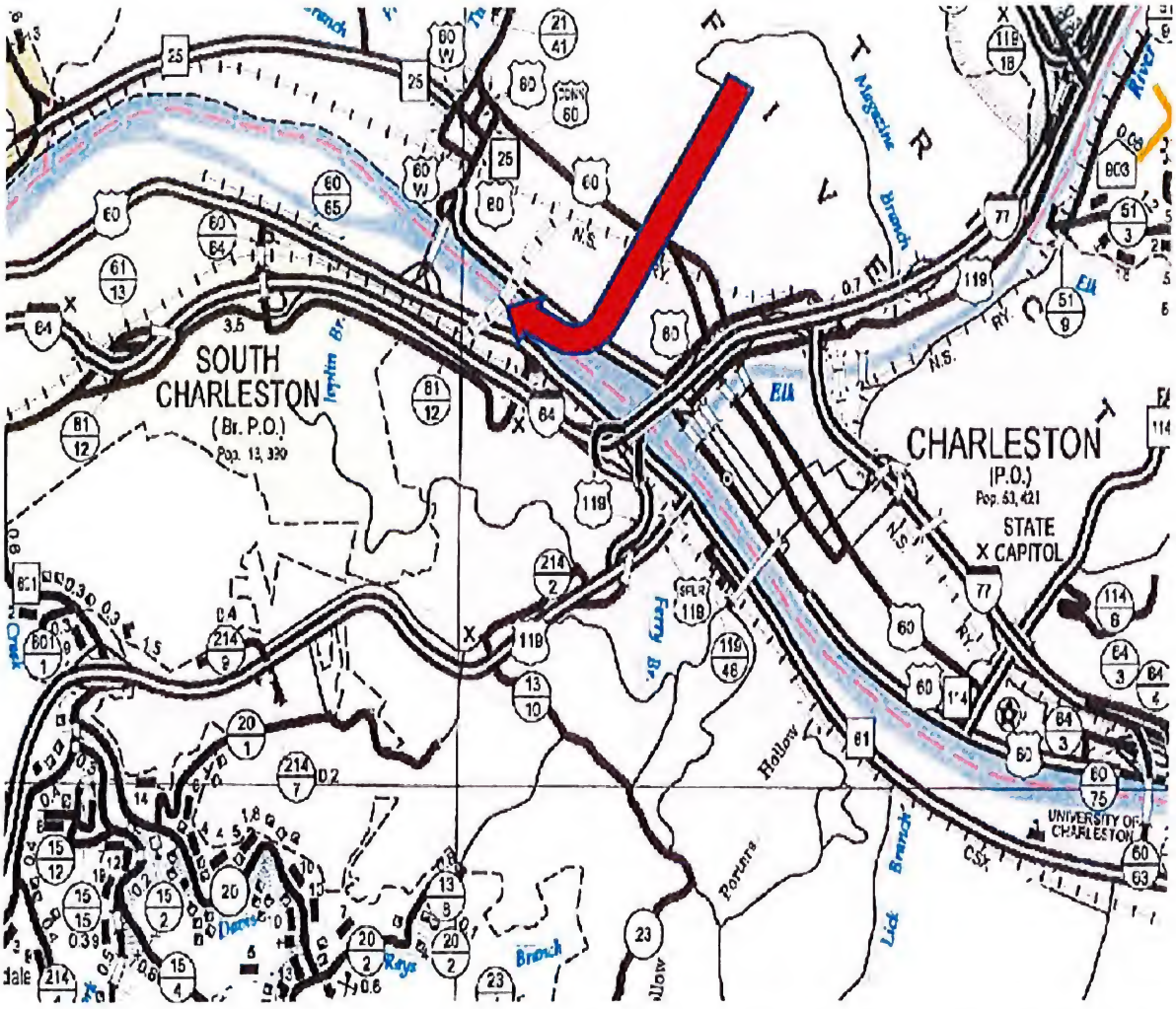


Figure 8. Location map for Railroad Truss Bridge over Kanawha River in Charleston, WV

APPENDIX B

Concrete Core Compressive Strength Worksheet
ASTM C 42

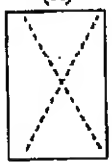
Project Name: CSX BRIDGE

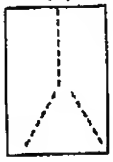
Project # : 04-11-0169 Date : 6/1/2011

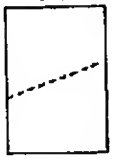
Core # : PIER 1 Type of Cure : AIR DRY

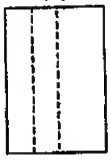
Measurements (Inches)		
	Length (After Cap)	Diameter
#1	5.973	3.676
#2	5.971	3.674
#3	5.974	3.675
Avg.	5.973	3.675

Length to Diameter Ratio :	1.63		Correction Factor:	0.970	
Area:	10.6073	in^2	Corrected Strength :	2539	lbs/in^2
Load:	27770	lbs	Moisture Condition:	DRY	
Compressive Strength:	2618	lbs/in^2	Type of Break:	B	









Remarks:

Concrete Core Compressive Strength Worksheet
ASTM C 42

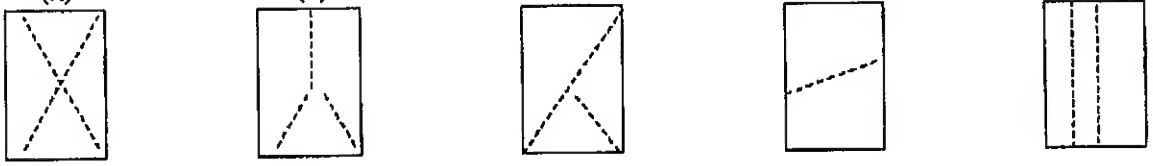
Project Name: CSX BRIDGE

Project # : 04-11-0169 Date : 6/1/2011

Core # : PIER 2 Type of Cure : AIR DRY

Measurements (inches)		
	Length (After Cap)	Diameter
#1	7.240	3.680
#2	7.240	3.680
#3	7.244	3.678
Avg.	7.241	3.679

Length to Diameter Ratio :	1.97		Correction Factor:	1.00	
Area:	10.6323	in^2	Corrected Strength :	2142	lbs/in^2
Load:	22770	lbs	Moisture Condition:	DRY	
Compressive Strength:	2142	lbs/in^2	Type of Break:	B	



Remarks:

Concrete Core Compressive Strength Worksheet
ASTM C 42

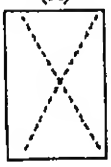
Project Name: CSX BRIDGE

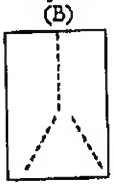
Project # : 04-11-0169 Date : 6/1/2011

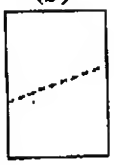
Core # : PIER 3 Type of Cure : AIR DRY

Measurements (inches)		
	Length (After Cap)	Diameter
#1	6.784	3.672
#2	6.781	3.672
#3	6.782	3.673
Avg.	6.782	3.672

Length to Diameter Ratio :	1.85	Correction Factor:	0.991
Area:	10.6919 in^2	Corrected Strength :	1567 lbs/in^2
Load:	16750 lbs	Moisture Condition:	DRY
Compressive Strength:	1581 lbs/in^2	Type of Break:	A







Remarks:

REI Consultants, Inc. Analytical Results

Date: *08-Jun-11*

CLIENT:	TRIAD ENGINEERING -ST ALBANS	**WorkOrder:**	1106134	**Lab ID** 1106134-01A
Client Sample ID:	PIER #1	**DateReceived:**	6/1/2011	
Project:	04-11-0169	**Collection Date:**	6/1/2011	
Site ID:	CSX BRIDGE	**Matrix:**	SOLID	

Analyses	Result	Units	Qual	MDL	PQL	Date Analyzed
ANIONS BY IC, WATER SOLUBLE			**SW9056**			Analyst: **CF**
Chloride	ND	mg/Kg		NA	20.0	6/7/2011 5:46:00 PM

Key:		
	MCL	Maximum Contaminant Level
	MDL	Minimum Detection Limit
	NA	Not Applicable
	ND	Not Detected at the PQL or MDL
	PQL	Practical Quantitation Limit
	TIC	Tentatively Identified Compound, Estimated Concentration
	B	Analyte detected in the associated Method Blank
	E	Estimated Value above quantitation range
	H	Holding times for preparation or analysis exceeded
	S	Spike/Surrogate Recovery exceeds REIC control limits
	*	Value exceeds MCL or Regulatory Limits

REI Consultants, Inc. **Analytical Results** **Date:** *08-Jun-11*

CLIENT:	TRIAD ENGINEERING -ST ALBANS	**WorkOrder:**	1106134	**Lab ID**	1106134-02A
Client Sample ID:	PIER #2	**DateReceived:**	6/1/2011		
Project:	04-11-0169	**Collection Date:**	6/1/2011		
Site ID:	CSX BRIDGE	**Matrix:**	SOLID		

Analyses	Result	Units	Qual	MDL	PQL	Date Analyzed
ANIONS BY IC, WATER SOLUBLE			**SW9056**			Analyst: **CF**
Chloride	21.8	mg/Kg		NA	20.0	6/7/2011 6:03:00 PM

Key:	MCL	Maximum Contaminant Level	B	Analyte detected in the associated Method Blank
	MDL	Minimum Detection Limit	E	Estimated Value above quantitation range
	NA	Not Applicable	H	Holding times for preparation or analysis exceeded
	ND	Not Detected at the PQL or MDL	S	Spike/Surrogate Recovery exceeds REIC control limits
	PQL	Practical Quantitation Limit	*	Value exceeds MCL or Regulatory Limits
	TIC	Tentatively Identified Compound, Estimated Concentration		

REI Consultants, Inc. **Analytical Results** **Date:** *08-Jun-11*

CLIENT:	TRIAD ENGINEERING -ST ALBANS	**WorkOrder:**	1106134	**Lab ID**	1106134-03A
Client Sample ID:	PIER #3	**DateReceived:**	6/1/2011		
Project:	04-11-0169	**Collection Date:**	6/1/2011		
Site ID:	CSX BRIDGE	**Matrix:**	SOLID		

Analyses	Result	Units	Qual	MDL	PQL	Date Analyzed
ANIONS BY IC, WATER SOLUBLE			**SW9056**			Analyst: **CF**
Chloride	ND	mg/Kg		NA	20.0	6/7/2011 6:20:00 PM

Key:	MCL	Maximum Contaminant Level	B	Analyte detected in the associated Method Blank
	MDL	Minimum Detection Limit	E	Estimated Value above quantitation range
	NA	Not Applicable	H	Holding times for preparation or analysis exceeded
	ND	Not Detected at the PQL or MDL	S	Spike/Surrogate Recovery exceeds REIC control limits
	PQL	Practical Quantitation Limit	*	Value exceeds MCL or Regulatory Limits
	TIC	Tentatively Identified Compound, Estimated Concentration		